General Background on Marine Protected Areas

There is increasing evidence of a wide range of benefits associated within Marine Protected Areas (MPAs) including increased numbers of species (biodiversity), increased fish sizes, higher reproductive potential, and protection of stocks from sequential depletion. Although most studies show that the benefits occur primarily within the boundaries of the MPAs, several studies have demonstrated benefits to adjacent fished areas. While much of this evidence comes from tropical systems, many studies of reserves in temperate systems, similar to those in California, are available. The most compelling example of the benefits of a large no-take reserve comes from the closures on the Georges Bank and vicinity (Murawski et al. 2000). A closure designed to protect between 17 percent and 29 percent of the area occupied by cod, haddock, and yellowtail flounder was established following stock declines. The latest stock assessments indicate significant increases in spawning stock biomass, attributed to increased adult survival. The closed areas also protect young cod and haddock, as well as unfished species. An unexpected benefit was an increase in scallop abundance both within and nearby the closed areas, with associated increases in catch.

In a West Coast example, reproductive potential of copper rockfish was 55 times greater in a 27-year-old reserve in the Puget Sound than in nearby fished areas. This enhanced reproductive potential was attributed to greater densities and larger sizes of rockfish inside the reserve (Palsson 1998). Similar increases in size and density were seen in a very small reserve in the San Juan Islands compared to adjacent unprotected areas (Palsson and Pacunski 1995). In California, reproductive potential for black-and-yellow rockfish inside two small reserves in Monterey Bay was 2 times greater in one reserve and 10 times greater in the second, as compared to fished areas immediately outside the reserves (Paddack 1996). Even a relatively new reserve (the Big Creek State Marine Reserve, established in 1994) appears to have significantly greater size distributions of several economically important rockfishes (M. Yoklavich, R. Lea, and G. Cailliet, unpublished data).

Similar benefits are reported for species associated with natural refugia (areas that are protected by the nature of the environment, such as depth or inaccessibility) and other unintentional protected areas. Abalone populations are greater in water depths beyond the range of free divers in northern California (Tegner et al. 1992). Regulations prohibiting the use of SCUBA to take abalone in this area form a de-facto deep water reserve. High numbers of large rockfishes are locally associated with isolated rock outcrops in deep water submarine canyons that are less accessible to fishing (Yoklavich et al. 2000). Density, diversity, and size of economically valuable fishes have increased within two unfished areas near the Kennedy Space Center at Cape Canaveral, Florida compared to nearby fished areas, and tagging studies have demonstrated movement of fishes from the protected areas into fished areas

(Bohnsack 1998; Johnson et al. 1999). In this same area, the number of recreational fishing records is significantly higher in the areas adjacent to the protected area than in the rest of Florida (Roberts et al. 2001).

MPAs may also provide benefits beyond their boundaries, such as exporting of larvae and "spillover" of adults to fishing areas, though there is less empirical evidence that shows this. The lack of evidence, however, is primarily due to the lack of research on this effect and the lack of appropriate MPAs that would be expected to show this effect. The example of increased numbers of record-size fish in areas adjacent to a protected area is one piece of evidence. Another example is shown in St. Lucia, a coral reef system, where nearly 35 percent of the fishing grounds were closed to all take in 1995. Within five years of creation, this network of five small reserves increased adjacent catches of artisanal fishermen by between 46 percent and 90 percent, depending on the type of gear used (Roberts et al. 2001).

A major benefit afforded to fisheries management through the use of MPAs is insurance against uncertainty. Many State managed populations are considered to be in what are called "data poor situations", with little information available on population size, population status, life history, and the magnitude of fishing mortality. This lack of information on basic life history and population status could lead to incorrect assumptions when making management decisions. Establishing MPAs that protect a portion of these populations could offer a buffer against uncertainties due to natural environmental fluctuations or the limited availability of biological information. MPAs are also useful areas to perform studies on basic life history or organisms and as comparison sites to determine the difference between natural and human-caused effects on marine populations.

The insurance provided by protecting a portion of populations within MPAs could help sustain local marine populations and provide a reproductive source to assist with rebuilding depleted stocks. By reducing mortality rates within MPAs, the average density, size, and age of previously fished species may increase. For many species, larger organisms are known to produce significantly more young, because the number of eggs the number of eggs produced by an individual increases dramatically with size. Populations with relatively sedentary adults will be more likely to benefit from MPA protection. Production outside an MPA will be due primarily or in larger part to larval export. In contrast, the density, size, age, and fecundity of relatively mobile species within an MPA will likely increase less compared with a sedentary species because of their movement in and outside MPA boundaries.

Environmental fluctuations play a large role in affecting the reproductive success of many marine species. These natural fluctuations affect the ability of a stock to sustain exploitation. A network of MPAs could provide a buffer against sporadic reproductive success of many species due to environmental fluctuations.

The protected portion of stocks might help sustain populations in years of poor reproductive success.

The following table summarizers potential expected benefits to populations that could be gained from a network of MPAs , based on the life history parameters of the species listed below (e.g. growth rates, reproductive strategies, life span, home range, etc.). To gain the fullest range of potential expected benefits, the network of MPAs would need to encompass a representative portion of a species habitat as well as a significant portion of a species lifecycle within individual MPA boundaries.

Table 1. Potential benefits of MPAs for a variety of species.

Potential Benefits	Habitat / Ecosystem Protection[1]	Insurance against Uncertainty[2]	Fisheries Benefits[3]	Protection when Aggregated[4]	Assist with Recovery[5]
Kelp bass	X				
Barred sand bass	X			X	
Abalone	X	X	X	X	X
Giant sea bass	X	X		X	X
White seabass	X			X	
Nearshore rockfishes	X	X	X	X	X
Shelf rockfishes	X	X	X	X	X
Sheephead	X	X			
Cabezon and greenlings	X	X	X	X	
Garibaldi	X				
Sea urchins	X	X		X	
Lobster	X				
California corbina	X				
Surfperches	X	X	X	X	
Crabs	X		X		
California halibut	X			X	
Ocean w hitefish	X				
Kelp	X				

[1] Critical habitats are protected in MPAs. These habitats may play an important role in various life history stages, from settling to adult. By protecting habitat, ecological interactions with other species are allowed (ecosystem protection). Might be more important for a sedentary species or for a particular life stage of an individual species.

[2] MPAs may protect a portion of residential stocks from accidental overfishing and uncertainty inherent in fisheries management, especially in fisheries that are data

poor. By protecting a portion of a stock from any take, at least that portion may be sustained over time. This would provide for long term availability of adults, protecting against sporadic reproductive success (common among many marine organisms) as well as insurance for uncertain population estimates. Transient stocks could also gain intermittent protection throughout State waters via a network. Garibaldi are currently protected from all take; they are very residential and appear to fully occupy their expected range. MPAs likely would not offer much protection for lobster populations since adults in California apparently are not the source of much spawning success here.

[3] Fisheries benefits outside MPAs may occur through larval export or adult migration. Based on knowledge of life history, it is expected that some species will migrate out of MPAs (spillover) or be actively transported out as larvae. Either of these occurrences could benefit populations and therefore fisheries outside MPA boundaries.

[4] MPAs may protect spawning, nursery, and aggregation areas. Protection during these critical periods provides significant benefit through increased success in recruitment and spawning. This protection includes times when individuals are guarding nests.

[5] MPAs may aide in the recovery of over-exploited populations. Certain species require minimum densities in order to successfully reproduce. These densities are more likely to be reached in MPAs than in areas where some limited take or even bycatch occurs. In addition, increases in reproductive success described above could help support recovery.